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Canopy Arthropods at Fernow Experimental Forest in West Virginia's Allegheny Mountain Section: II. Macrolepidopterous Larvae on Foliage and Under Burlap Bands

Linda Butler, Gregory Chrislip and Vicki Kondo

INTRODUCTION

In recent years, we have conducted a number of studies in West Virginia on species composition of the macrolepidoptera in canopies of hardwood forests. These studies have been for the collection of baseline data only (Butler 1992) and for the evaluation of impacts of gypsy moth suppression efforts (Butler and Kondo 1993; Sample et al. 1995).

In 1989 we began a study to evaluate non-target impact of the insect growth regulator Dimilin (1-(4 chlorophenyl)-3-(2, 6-diflubenzoyl) urea) or diflubenzuron on canopy arthropods. Dimilin has been applied to hundreds of thousands of acres in the United States for suppression of gypsy moth, *Lymantria dispar* (L.) (Lepidoptera: Lymantriidae) (USDA Forest Service 1990). From 1989 through 1994 we sampled canopy arthropods in four closed watersheds on the Fernow Experimental Forest near Parsons in the Allegheny Mountain section of West Virginia. In 1992 Dimilin was applied to two of the watersheds. Elsewhere we present results of impact of Dimilin on canopy arthropods and evaluation of macrolepidopterous moths sampled by blacklight trap. Here we present richness and abundance of macrolepidoptera larvae taken from foliage and collected from burlap bands on mixed birch (*Betula* spp.), black cherry (*Prunus serotina* Ehrh.), mixed maples (*Acer* spp.) and mixed oaks (*Quercus* spp.) during the six-year study period. Used in this context, richness refers to number of species of larvae, abundance refers to total numbers.

MATERIALS AND METHODS

Study Sites

The Fernow Experimental Forest is located on the unglaciated Allegheny Plateau (latitude 39° 05'N, longitude 79° 41'W) at elevations ranging from 533 to 1,112 m. The topography is rugged with slopes of 10 to 60 percent. The experimental forest encompasses 1,902 ha and has been divided into a series of water-

sheds for research purposes. This study was conducted on watersheds 1, 4, 7, and 13.

Prior to establishment of the Fernow Experimental Forest (FEF) in 1934, the land was heavily cut between 1905 and 1910. Additional timbering occurred on several of the four watersheds from the early 1950s through the late 1970s. Currently the common tree species on the better sites include yellow-poplar (*Liriodendron tulipifera* L.), sugar maple (*Acer saccharum* Marsh.), black cherry, white ash (*Fraxinus americana* L.), American basswood (*Tilia americana* L.) and red oak (*Quercus rubra* L.). Dominant tree species on the poorer sites include various species of oak (*Quercus* spp.), hickory (*Carya* spp.), sourwood (*Oxydendrum arboreum* (L.) DC) and sassafras (*Sassafras albidum* (Nutt.) Nees) (Adams et al. 1993).

Importance values (IV) for tree species on watersheds 1, 4, 7, and 13 were determined by Stephenson 1992 (unpublished) in which he evaluated species on five small plots (100 m^2) within each watershed, well away from watershed boundaries. All plants with stems greater than 2.5 cm DBH (diameter at breast height) were considered to be trees. Individual tree species were given an importance value by adding the relative basal area plus relative density and dividing by two. Stephenson's importance values are used to characterize tree composition on the four watersheds that comprised this study.

Watershed 1 is 30.1 ha with a NE aspect. It has not been timbered since 1958. Tree species with the highest importance values were sugar maple, basswood, beech (*Fagus grandifolia* Ehrh.), black locust (*Robinia pseudoacacia* L.), cucumber magnolia (*Magnolia acuminata* L.) and red oak. Importance values for the four species groups sampled in this study were 29.2 for sugar maple, 2.6 and 1.5 for yellow birch (*Betula lutea* Michx. f.) and black birch (*Betula lenta* L.), respectively, and 3.7 for red oak. Red maple (*Acer rubrum* L.) and black cherry were sparse on watershed 1.

Watershed 4 is 38.7 ha with an ESE aspect. Most abundant tree species with respect to importance values were beech, sugar maple, moosewood (*Acer pensylvanicum* L.), yellow-poplar, American basswood and red oak. Importance values for trees sampled in this study were 16.6 and 2.4 for sugar maple and red maple, respectively, 1.0 for black birch and 7.4 for red oak. Black cherry was represented on watershed 4 by a few large trees and abundant young trees in the understory, but the young trees were too small to have been counted in Stephenson's importance values. Watershed 4 is a relatively mature forest not having been timbered since 1910.

Watershed 7 is 24.2 ha with an E aspect. It is the youngest of the forest stands, having been last cut and treated with herbicides in 1969. Most abundant species (IV) were black birch, sugar maple, red oak, and yellow-poplar. Importance values of trees sampled in this study were 15.4 for sugar maple, 9.2 for red oak, 33.3 for black birch and 8.4 for black cherry.

Watershed 13 is 14.2 ha with a NNE aspect. Light-selective timbering of this watershed occurred until 1960, but it is a relatively mature stand. Predominant species (IV) were sugar maple, red oak, yellow-poplar, black cherry and black birch. Importance values for species utilized in this study were 30.5 for sugar maple, 1.1 for red maple, 29.3 for red oak, 6.4 for black birch and 6.6 for black cherry.

Sampling Methods

We began sampling macrolepidopterous larvae on all four watersheds in 1989 by means of burlap banding of trees and pole pruning of foliage.

Burlap bands 24 cm wide were stapled at breast height to trees. Ten trees each of black birch and black cherry were banded in late April 1989 on all four watersheds. Ten mixed maples were added on each watershed on July 5, 1989. Ten mixed oaks per watershed were added in early May 1990, giving a total of 160 banded trees for the study. Each year bands were installed in late April and sampling was begun early to mid-May: May 4, 1989; May 14, 1990; May 6, 1991; May 11, 1992; May 10, 1993; and May 9, 1994. Bands were left in place until early to mid-August each year and then removed after the last sampling date: August 15, 1989; August 13, 1990; August 12, 1991; August 10, 1992; August 9, 1993; and August 8, 1994. Each week all bands were checked and all macrolepidoptera larvae removed and returned to the laboratory for identification to species. Burlap bands mimic naturally occurring bark flaps and provide a refuge for sampling caterpillars that move up and down the trunks.

The first foliage samples were taken May 17, 1989 and consisted of two 25-branch tip samples of mixed birch (black and yellow) and two of black cherry on each of the four watersheds, for a total of 16 samples per sampling date. On June 27, 1989 a similar sampling procedure was added for mixed maple (sugar and red) so that 24 samples were being taken for the remainder of the season. Sampling of mixed oak (primarily red oak) was added at the beginning of the 1990 sampling season, giving a total of 32 samples of foliage on each sampling date.

Foliage sampling was begun soon after leaf expansion each spring: May 17, 1989; May 15, 1990; May, 7, 1991; May 12, 1992; May 11, 1993; and May 8, 1994 and was continued until mid-August each year. During the six years of the study, foliage samples were taken each week for a total of 15 sampling dates each season. Foliage was collected from low- to mid-canopy with pole pruners that were equipped with large plastic catch bags to collect the foliage that fell.

The 32 foliage samples of mixed birch, black cherry, mixed maple and mixed oak were returned to the laboratory where all macrolepidoptera larvae were removed and identified to species by spot identification, comparison with voucher specimens in the WVU Arthropod Collection, comparison with color slides of macrolepidoptera prepared in our laboratory or by rearing the larva to the adult moth for positive identification.

After larvae were removed, all leaves were removed from twigs in each sample, placed in paper bags, oven dried, and weighed. Samples averaged about 50 grams dry leaf weight.

On May 16, 1992, Dimilin 4L was applied to watersheds 1 and 13 at a rate of 0.5 oz. AI/acre. Elsewhere we will discuss impact of that treatment on macrolepidopterous larvae. Here we present overall richness and abundance of larvae during the six-year study on the Fernow and present information on seasonal range and host associations.

Voucher specimens from the study are deposited in the WVU Arthropod Collection. Species are listed according to the checklist given by Hodges et al. (1983).

RESULTS

A total of 86 species of macrolepidopterous larvae representing 10 families was taken from bands and 111 species from 13 families were collected on foliage from 1989 through 1994 (Table 1). Most larvae collected by both methods were Noctuidae and Geometridae. Under bands, noctuid richness (39 species) was highest with geometrids contributing 24 species. On foliage geometrid richness (43 species) was highest with noctuids representing 36 species. The third richest family was Notodontidae with 12 species on foliage and 6 species under bands. While more families of macrolepidoptera were taken on foliage, sampling by bands allowed evaluation of several species not encountered on foliage, particularly with noctuids and arctiids (Table 1).

The most abundant larva under bands was the gypsy moth *Lymantria dispar* (Table 2). When the study began in 1989 almost no *L. dispar* were found, but their numbers gradually built up and became noticeably abundant by 1994. Not unexpected was the fact that most gypsy moth larvae were found under bands of oaks, their preferred hosts. Of the remaining species of larvae the most abundant were the noctuids *Polia latex* (Gn.), *Orthosia rubescens* (Wlk.), *Abagrotis alternata* (Grt.), *Lithophane hemina* Grt., *L. innominata* (Sm.) and *Zale minerea* (Gn.) and the lasiocampids *Malacosoma disstria* Hbn. and *M. americanum* (F.).

Since burlap bands mimic bark flaps on trees and provide insects with shelter, associating a species of caterpillar with a specific host food tree on the basis of catches under bands is problematic. Many of the species taken under bands are herbivorous on a number of deciduous host trees (Table 2). This is reflected by relatively even numbers of larvae for the host species groups; examples of generalists include *Orthosia rubescens*, *Lithophane hemina* and *Malacosoma disstria*. *Polia latex* is considered a generalist (Wood and Butler 1989) but it was taken in much greater abundance under bands on cherry trees in this study. *Abagrotis alternata* is a general feeder on many tree species (Forbes 1954) but frequently feeds on blueberry (*Vaccinium* spp.) and other low woody plants and

climbs trees to seek shelter. *Malacosoma americanum* strongly prefers black cherry but was found commonly under bands of all tree species in the study.

Most species of larvae recorded from tree bands in this study were in very low numbers. Sixty-one of the 86 species were represented by fewer than 20 individuals over the six-year period and 25 species were recorded as single individuals.

Species of macrolepidopterous larvae taken from foliage of the four tree species groups are listed in Table 3. Five species of geometrid larvae were the most abundant: *Lomographa glomeraria* (Grt.), *Erannis tiliaria* (Harr.), *L. vestaliata* (Gn.), *Melanolophia canadaria* (Gn.) and *Alsophila pometaria* (Harr.). Two noctuids, *Orthosia hibisci* (Gn.) and *Polia latex*, were next most abundant. Of the 17 species represented by more than 100 individuals during the study, 10 were geometrids, 6 were noctuids and one was a lymantriid, the gypsy moth.

Several of the more abundant species are generalists on a number of tree species: *Erannis tiliaria, Melanolophia canadaria, Alsophila pometaria, Orthosia hibisci* and *Polia latex*, for example. *Erannis tiliaria* and *A. pometaria* tend to be outbreak species (Butler 1985), but their numbers were stable and generally low at the FEF.

A number of species showed strong food tree preferences. *Lomographa glomeraria, L. vestaliata, L. semiclarata* (Wlk.), and *Hydria prunivorata* (Fgn.) are black cherry feeders; *Itame pustularia* (Gn.) and *Symmerista leucitys* Franc. feed on maple and *Catocala ilia* (Cram.) feeds on oak.

Seventy-one of the 111 species on foliage were represented by fewer than 20 individuals; 16 species were represented by a single caterpillar.

The highest richness of larvae on foliage was recorded for mixed oak with 72 species (Table 4). Black cherry accounted for 71 species and had the greatest abundance of larvae at 3,188, primarily because of the large numbers of *Lomographa* spp. Identical species richness (57 species) was noted for black birch and mixed maple. Abundance of larvae was similar among black birch, mixed maple and mixed oak (Table 4). Gypsy moth larvae accounted for 284 of the 1,387 individuals on oak.

Dates of first collection and last collection are given for all species of caterpillars under bands and on foliage (Tables 2, 3). Some larvae occurred throughout most of the May–August period and represent species that are univoltine and abundant, but are not highly synchronized for dates of moth emergence and oviposition. Therefore larvae are hatching over a several week period; *Polia latex* and *Morrisonia confusa* (Hbn.) are examples. Long collection periods are also expected for multivoltine species (species with more than one generation per year), such as the geometrids *Melanolophia canadaria* and *Lomographa vestaliata*. Species that are more restricted to a portion of the season include the spring defoliating geometrids and noctuids such as *Erannis tiliaria, Alsophila pometaria* and *Orthosia hibisci*.

DISCUSSION

A total of 130 species of macrolepidopterous larvae were identified during this study (86 from bands and 111 from foliage). Richness and abundance of macrolepidopterous caterpillars are comparable to that reported from other recent studies in West Virginia (Butler 1992; Butler et al. 1995a).

In 1984 and 1985 a baseline study was conducted at Coopers Rock State Forest in which 100 species of macrolepidopterous larvae in 14 families were identified from foliage of the same four tree species groups utilized in the Fernow study. A higher number of species of both noctuids and geometrids primarily accounts for the greater overall richness in the Fernow study.

Ninety-one species of macrolepidopterous caterpillars from 10 families were identified from oak foliage in the *Bacillus thuringiensis kurstaki (Btk)* non-target impact study conducted in Pendleton and Grant counties in West Virginia's Eastern Ridge and Valley section in 1990–1992 (Sample et al. 1995; Butler et al. 1995a). The 91 species on oak alone is considerably higher than the 61 species on oak at Coopers Rock and the 72 species on oak at Fernow; however, the sampling intensity of oak in the *Btk* study exceeded that of the Coopers Rock and current study by 2–3 fold. Table 3 indicates the species taken in the current study that were not represented at one or both sites of the two earlier studies. The comparison for Grant and Pendleton counties includes only those oak species for which oak is an expected host.

Coopers Rock and Fernow are both within West Virginia's Allegheny Mountain section and we might expect the caterpillar fauna to be similar. The 38 species taken on foliage at Fernow but not at Coopers Rock include 15 species of geometrids, 18 species of noctuids, a lasiocampid, a notodontid, a lycaenid, and two nymphalids (Table 3). We note that the Coopers Rock study was conducted for two years and the Fernow study for six, but during each year, samples were collected until October at Coopers Rock but only until mid-August at Fernow. Twenty-four of the 38 species not collected at Coopers Rock were represented at Fernow by three or fewer individuals over the six years. One would expect that species that are in very low abundance may have been taken at Coopers Rock with either greater sampling intensity during each of the two years, or by extending the study for more years. All of the 38 species not taken at Coopers Rock are expected to be there with the possible exception of the noctuid *Copipanolis styracis* (Gn.), which has only been collected commonly in the more eastern oak-pine habitats of the state (Butler et al. 1995a).

Species taken at Coopers Rock that were not represented at Fernow include the hesperiid *Erynnis juvenalis* (F.); the geometrids *Semiothisa aemulataria* (Wlk.), *Paleacrita merriccata* Dyar and *Anagoga occiduaria* (Wlk.); the apatelodid *Apatelodes torrefacta* (J.E. Smith); the saturniids *Eacles imperialis* (Drury), *Anisota senatoria* (J.E. Smith), *Automeris io* (F.), *Antheraea polyphemus* (Cram.),

Callosamia promethea (Drury) and *Callosamia angulifiera* (Wlk.); the notodontids *Hyperaeschra georgica* (H.-S.) and *Oligocentria lignicolor* (Wlk.); the arctiids *Halysidota harrisii* Walsh and *Lophocampa caryae* Harr.; and the noctuids *Panopoda rufimargo* (Hbn.), *Cerma cerintha* (Tr.), *Acronicta increta* Morr., *A. inclara* Sm., *A. retardata* (Wlk.), *A. impleta* Wlk., *Phosphila turbulenta* Hbn. and *Himella intractata* (Morr.). All of these species were taken at Coopers Rock in very low numbers and/or late in the season, i.e., August–October when samples were not taken at Fernow.

Eighty-six species of macrolepidopterous larvae were taken from bands at Fernow from 1989–1994. In a Dimilin impact study at Coopers Rock in 1990 and 1991, 42 species of larvae representing eight families were taken from bands (Butler and Kondo 1993). The Coopers Rock study employed 80 banded trees from mid-April until mid-September each of the two years in comparison with 160 banded trees evaluated from mid-May until mid-August for six years at Fernow. Some similar results are noted with respect to the composition of the most abundant species. At both sites, the gypsy moth, *Lymantria dispar* was most abundant. *Polia latex*, which was second most abundant at Fernow, was third most abundant at Coopers Rock. Other examples of more abundant species at Fernow are ranked with comparisons of rank for species at Coopers Rock: *Orthosia rubescens* (3 versus 16), *Abagrotis alternata* (4 versus 2), *Lithophane hemina* (5 versus 19), *Malacosoma disstria* (6 versus 14), *Zale minerea* (8 versus 21), and *Malacosoma americanum* (9 versus 10). *Lithophane innominata*, the seventh most abundant species at Fernow, was not taken under bands at Coopers Rock.

Relatively abundant species taken at Coopers Rock that were relatively less abundant at Fernow include *Orthosia hibisci* (number 4 at Coopers Rock, number 15 at FEF), *Halysidota tesselaris* (J.E. Smith) (5 versus 24), *Epiglaea decliva* (Grt.) (6 versus 14), *Orgyia leucostigma* (J.E. Smith) (7 versus 36), *Polia nimbosa* (Gn.) (8 versus 60), *Dasychira basiflava* (Pack.) (9 versus 32) and *Dasychira dorsipennata* (B. & McD.) (11 versus 28). The noctuid *Polia detracta* (Wlk.) was the only species taken under bands at Coopers Rock that was not represented either under bands or on foliage at Fernow.

During 1990–1994 we sampled macrolepidopterous moths on the four watersheds at Fernow by means of blacklight traps (Butler et al. 1995b). The most abundant moths were *Itame pustularia*, *Hydrelia inornata* (Hulst), *Lomographa glomeraria*, *L. vestaliata*, *Halysidota tesselaris*, *Probole amicaria* (H.-S.), *Melanolophia canadaria* and *Iridopsis larvaria* (Gn.). Five of the 12 most abundant larval species on foliage are represented here in this group.

A total of 376 species of macrolepidopterous moths was collected at Fernow (Butler et al. 1995b); in this paper we have listed 130 species of larvae on four host plant groups. Some species of moths were not represented in larval collections because we did not sample the appropriate host. For example, *Euphyia*

unangulata (Haw.) larvae feed on chickweed (Forbes 1948), and *Clemensia albata* Pack. larvae feed on dead leaves (Forbes 1960). A number of species of larvae were collected that were not represented as adults in light traps, for example, *Erannis tiliaria* and *Alsophila pometaria*, whose males fly in November (females are flightless) and *Phigalia titea*, whose males fly in March (females are flightless).

This six year study of macrolepidopterous larvae on foliage and under tree bands at Fernow resulted in the identification of 130 species of larvae on the study plots, indicating a high diversity of species.

SUMMARY

Macrolepidopterous larvae were collected from foliage and bands of black birch, black cherry, mixed maples and mixed oaks from May–August 1989–1994. Collections resulted in 130 species of larvae. No species were sufficiently abundant to be considered in outbreak mode, although gypsy moth larval populations were building in the watersheds. Little defoliation was evident. While foliage pruning and tree banding produced 111 and 86 species of larvae respectively, the sampling methods complement each other for evaluating species richness.

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TABLE 1.
Distribution of species of macrolepidopterous larvae by family; number of species of larvae collected from tree foliage and from tree bands at the Fernow Experimental Forest, WV 1989–1994.

Family	Foliage	Bands
Papilionidae	1	1
Lycaenidae	2	1
Nymphalidae	2	0
Thyatiridae	1	1
Drepanidae	1	0
Geometridae	43	24
Lasiocampidae	2	2
Saturniidae	3	0
Sphingidae	1	2
Notodontidae	12	6
Arctiidae	2	5
Lymantriidae	5	5
Noctuidae	36	39
TOTAL	111	86

TABLE 2
Macrolepidopterous larvae under bands of four host tree groups at the Fernow Experimental Forest, West Virginia. Species are arranged from most to least abundant for the combined sampling years of 1989–1994. First and last collection dates are given.

		No. per host tree					Collection Dates	
Species	Family[1]	Birch	Cherry	Maple	Oak	Total	First	Last
Lymantria dispar (L.)	LYM	734	550	878	2267	4429	06MAY	13AUG
Polia latex (Gn.)	NOC	138	402	100	98	738	10JUN	15AUG
Orthosia rubescens (Wlk.)	NOC	107	197	46	135	485	20MAY	04JUL
Abagrotis alternata (Grt.)	NOC	39	40	32	108	219	06MAY	27JUN
Lithophane hemina Grt.	NOC	64	48	66	28	206	20MAY	23JUL
Malacosoma disstria Hbn.	LAS	10	60	24	38	132	09MAY	22JUN
Lithophane innominata (Sm.)	NOC	21	24	59	9	113	06JUN	11JUL
Zale minerea (Gn.)	NOC	7	68	20	8	103	11MAY	13AUG
Malacosoma americanum (F.)	LAS	24	46	17	10	97	16MAY	04JUL
Erannis tiliaria (Harr.)	GEO	11	15	17	27	70	13MAY	29JUN
Catocala ultronia (Hbn.)	NOC	9	50	7	2	68	17MAY	12JUL
Melanolophia canadaria (Gn.)	GEO	13	9	11	25	58	06MAY	10AUG
Hyphantria cunea (Drury)	ARC	11	24	6	9	50	24JUN	12AUG
Epiglaea decliva (Grt.)	NOC	8	10	14	11	43	06MAY	07JUN
Orthosia hibisci (Gn.)	NOC	15	9	6	11	41	18MAY	13JUL
Acronicta hasta Gn.	NOC	2	33	2	0	37	28JUN	15AUG

continued

Species	Family[1]	No. per host tree					Collection Dates	
		Birch	Cherry	Maple	Oak	Total	First	Last
Alsophila pometaria (Harr.)	GEO	4	9	5	18	36	06MAY	08JUN
Dasychira obliquata (G. & R.)	LYM	4	10	11	10	35	06MAY	05AUG
Itame pustularia (Gn.)	GEO	2	4	11	17	34	09MAY	21JUN
Phigalia titea (Cram.)	GEO	8	6	10	7	31	13MAY	18JUN
Phoberia atomaris Hbn.	NOC	0	6	1	22	29	20MAY	12JUL
Catocala ilia (Cram.)	NOC	1	2	0	24	27	06MAY	09AUG
Hypoprepia fucosa Hbn.	ARC	5	2	6	8	21	09MAY	01AUG
Halysidota tessellaris (J.E. Smith)	ARC	4	2	4	10	20	17JUN	13AUG
Amphipyra pyramidoides Gn.	NOC	5	4	5	6	20	21MAY	15AUG
Catocala amica (Hbn.)	NOC	1	7	5	5	18	03JUN	19JUL
Crocigrapha normani (Grt.)	NOC	4	11	1	0	16	20JUN	19JUL
Dasychira dorsipennata (B. & McD.)	LYM	2	3	4	3	12	28MAY	23JUL
Lomographa vestaliata (Gn.)	GEO	5	3	0	2	10	25MAY	10AUG
Lomographa glomeraria (Grt.)	GEO	0	4	2	4	10	20MAY	27JUN
Lithophane laticinerea Grt.	NOC	5	1	1	2	9	24MAY	21JUN
Dasychira basiflava (Pack.)	LYM	2	3	2	1	8	06MAY	12AUG
Satyrium calanus (Hbn.)	LYC	0	1	2	4	7	28MAY	17JUN
Papilio glaucus L.	PAP	1	1	1	2	5	10JUN	12JUL
Hydrelia inornata (Hulst)	GEO	1	2	2	0	5	08JUL	15JUL
Orgyia leucostigma (J.E. Smith)	LYM	0	0	3	2	5	10JUN	01JUL
Bomolocha baltimoralis (Gn.)	NOC	0	0	4	1	5	30MAY	09AUG
Lithophane grotei Riley	NOC	3	0	1	1	5	30MAY	12JUL
Epimecis hortaria (F.)	GEO	1	2	1	0	4	06MAY	12JUL
Hypagyrtis unipunctata (Haw.)	GEO	1	2	0	1	4	23MAY	13AUG
Zale lunifera (Hbn.)	NOC	0	4	0	0	4	20MAY	16JUL
Achatia distincta Hbn.	NOC	1	2	0	1	4	24JUN	13JUL
Morrisonia confusa (Hbn.)	NOC	2	2	0	0	4	13MAY	15AUG
Lambdina fiscellaria (Gn.)	GEO	0	1	0	2	3	01JUL	15JUL
Paonias myops (J.E. Smith)	SPH	1	1	0	1	3	01JUL	15JUL
Lithophane antennata (Wlk.)	NOC	1	1	1	0	3	23MAY	20JUN
Pseudothyatira cymatophoroides (Gn.)	THY	2	0	0	0	2	08JUL	05AUG
Phigalia strigataria (Minot)	GEO	0	1	0	1	2	20MAY	25MAY
Lomographa semiclarata (Wlk.)	GEO	0	1	0	1	2	25JUL	01AUG
Lambdina pellucidaria (G. & R.)	GEO	0	0	0	2	2	16JUL	22JUL
Tetracis cachexiata Gn.	GEO	0	1	0	1	2	03JUN	25JUL
Eutrapela clemataria (J.E. Smith)	GEO	1	0	0	1	2	28MAY	08JUL

continued

[1]LYM = Lymantriidae, NOC = Noctuidae, LAS = Lasiocampidae, GEO = Geometridae, ARC = Arctiidae, LYC = Lycaenidae, PAP = Papilionidae, SPH = Sphingidae, THY = Thyatiridae, NOT = Notodontidae.

Species	Family[1]	No. per host tree					Collection Dates	
		Birch	Cherry	Maple	Oak	Total	First	Last
Schizura unicornis (J.E. Smith)	NOT	0	2	0	0	2	18JUN	12AUG
Parallelia bistriaris Hbn.	NOC	0	0	2	0	2	01JUL	30JUL
Acronicta fragilis Gn.	NOC	0	0	1	1	2	15JUL	30JUL
Alypia octomaculata (F.)	NOC	1	1	0	0	2	01JUL	01AUG
Phlogophora periculosa Gn.	NOC	1	1	0	0	2	17MAY	31MAY
Lithophane unimoda (Lint.)	NOC	0	2	0	0	2	31MAY	31MAY
Eupsilia vinulenta (Grt.)	NOC	1	0	0	1	2	24MAY	24MAY
Polia nimbosa (Gn.)	NOC	0	1	1	0	2	06MAY	14MAY
Himella intractata (Morr.)	NOC	0	1	0	1	2	20JUN	20JUN
Protoboarmia porcelaria (Gn.)	GEO	0	0	0	1	1	26JUL	26JUL
Selenia kentaria (G. & R.)	GEO	1	0	0	0	1	27JUN	27JUN
Probole amicaria (H.-S.)	GEO	0	0	0	1	1	05AUG	05AUG
Eulithis diversilineata (Hbn.)	GEO	0	1	0	0	1	01JUL	01JUL
Hydria prunivorata (Fgn.)	GEO	0	1	0	0	1	25MAY	25MAY
Hydrelia condensata (Wlk.)	GEO	0	0	1	0	1	08AUG	08AUG
Eupithecia herefordaria C. & S.	GEO	0	0	1	0	1	07JUN	07JUN
Cladara atroliturata (Wlk.)	GEO	0	0	1	0	1	06JUN	06JUN
Darapsa myron (Cram.)	SPH	0	1	0	0	1	04JUL	04JUL
Nadata gibbosa (J.E. Smith)	NOT	0	0	0	1	1	02AUG	02AUG
Symmerista leucitys Franc.	NOT	0	0	1	0	1	08AUG	08AUG
Macrurocampa marthesia (Cram.)	NOT	0	0	0	1	1	15JUL	15JUL
Heterocampa guttivitta (Wlk.)	NOT	0	0	0	1	1	29JUL	29JUL
Lochmaeus manteo Doubleday	NOT	0	0	1	0	1	15JUL	15JUL
Ecpantheria scribonia (Stoll)	ARC	0	0	0	1	1	30MAY	30MAY
Lophocampa caryae Harr.	ARC	0	0	1	0	1	05AUG	05AUG
Idia julia (B. & McD.)	NOC	0	0	1	0	1	09JUL	09JUL
Idia scobialis (Grt.)	NOC	0	0	1	0	1	10JUN	10JUN
Zale lunata (Drury)	NOC	0	1	0	0	1	09JUL	09JUL
Acronicta americana (Harr.)	NOC	0	0	1	0	1	09AUG	09AUG
Acronicta innotata Gn.	NOC	1	0	0	0	1	12AUG	12AUG
Acronicta lobeliae Gn.	NOC	0	0	0	1	1	17JUN	17JUN
Eudryas grata (F.)	NOC	1	0	0	0	1	12AUG	12AUG
Eutolype rolandi Grt.	NOC	1	0	0	0	1	21JUN	21JUN
Psaphida resumens Wlk.	NOC	0	1	0	0	1	01JUN	01JUN

[1]LYM = Lymantriidae, NOC = Noctuidae, LAS = Lasiocampidae, GEO = Geometridae, ARC = Arctiidae, LYC = Lycaenidae, PAP = Papilionidae, SPH = Sphingidae, THY = Thyatiridae, NOT = Notodontidae.

TABLE 3. Macrolepidopterous larvae collected from foliage of four host tree groups at the Fernow Experimental Forest, West Virginia. Species are arranged from most to least abundant for the combined sampling years of 1989-1994. First and last collection dates are given.

Species[2,3]	Family[1]	No. per host tree					Collection Dates	
		Birch	Cherry	Maple	Oak	Total	First	Last
Lomographa glomeraria (Grt.)	GEO	13	795	4	3	815	10MAY	28JUN
Erannis tiliaria (Harr.)	GEO	275	143	159	214	791	07MAY	19JUN
Lomographa vestaliata (Gn.)	GEO	7	664	7	7	685	30MAY	15AUG
Melanolophia canadaria (Gn.)	GEO	106	323	134	77	640	07MAY	15AUG
Alsophila pometaria (Harr.)	GEO	44	202	62	219	527	07MAY	23JUN
Orthosia hibisci (Gn.)	NOC	217	108	23	107	455	07MAY	28JUN
Polia latex (Gn.)	NOC	77	107	101	51	336	07JUN	15AUG
Itame pustularia (Gn.)	GEO	0	5	287	2	294	07JUN	15AUG
Lymantria dispar (L.)	LYM	28	12	48	201	289	07MAY	29JUN
Hydria prunivorata (Fgn.)	GEO	0	193	0	0	193	18JUN	13AUG
Morrisonia confusa (Hbn.)	NOC	46	77	21	17	161	29MAY	15AUG
Hydrelia inornata (Hulst)[3]	GEO	45	21	79	11	156	10MAY	15AUG
Phigalia titea (Cram.)	GEO	30	33	22	68	153	07MAY	13JUN
Campaea perlata (Gn.)	GEO	36	48	44	11	139	07MAY	15AUG
Orthosia rubescens (Wlk.)	NOC	54	25	24	19	122	10MAY	07JUL
Eupsilia sidus (Gn.)[2]	NOC	99	1	2	12	114	07MAY	07JUN
Amphipyra pyramidoides Gn.	NOC	10	46	23	24	103	07MAY	15JUN
Lomographa semiclarata (Wlk.)	GEO	0	72	1	1	74	04JUN	20JUL
Hyphantria cunea (Drury)	ARC	21	8	9	35	73	22MAY	13AUG
Eupsilia n. sp.[2]	NOC	20	15	7	24	66	10MAY	10JUN
Symmerista leucitys Franc.	NOT	0	0	49	0	49	26JUL	09AUG
Halysidota tessellaris (J.E. Smith)	ARC	7	10	7	20	44	02JUL	15AUG
Tetracis cachexiata Gn.	GEO	11	21	7	4	43	07MAY	15AUG
Lithophane hemina Grt.	NOC	11	17	13	1	42	23MAY	06JUL
Hydrelia condensata (Wlk.)[2]	GEO	14	1	22	3	40	13JUL	10AUG
Lochmaeus manteo Doubleday	NOT	2	0	0	37	39	29JUN	14AUG
Peridea basitriens (Wlk.)	NOT	1	0	38	0	39	05JUL	14AUG
Besma quercivoraria (Gn.)	GEO	4	0	0	34	38	11MAY	03AUG
Phigalia strigataria (Minot)[2]	GEO	18	5	2	10	35	07MAY	12JUN
Iridopsis larvaria (Gn.)	GEO	1	33	0	0	34	04JUN	03AUG
Besma endropiaria (G. & R.)	GEO	0	3	26	5	34	01JUN	10AUG
Malacosoma disstria Hbn.[2]	LAS	0	4	2	27	33	12MAY	12JUN
Dryocampa rubicunda (F.)	SAT	0	0	31	0	31	09JUL	16JUL

continued

[1]GEO = Geometridae, NOC = Noctuidae, ARC = Arctiidae, LAS = Lasiocampidae, NOT = Notodontidae, LYM = Lymantriidae, SAT = Saturniidae, DRE = Drepanidae, SPH = Sphingidae, THY = Thyatiridae, PAP = Papilionidae, NYM = Nymphalidae, LYC = Lycaenidae.

[2]Species that were not collected at Coopers Rock, 1984-1985 (Butler 1992).

[3]Species collected on oak at Fernow that were not collected in Grant and Pendleton counties, 1990–1992 (Butler et al. 1995a). Oak is an expected host for these species.

Species	Family[1]	No. per host tree					Collection Dates	
		Birch	Cherry	Maple	Oak	Total	First	Last
Anavitrinella pampinaria (Gn.)	GEO	9	21	0	0	30	14MAY	18JUN
Acronicta fragilis Gn.	NOC	19	7	2	0	28	04JUN	14AUG
Eupithecia miserulata Grt.	GEO	0	19	6	1	26	29MAY	25JUL
Eupithecia herefordaria C. & S.[2]	GEO	5	13	6	0	24	07JUN	05JUL
Satyrium calanus (Hbn.)	LYC	0	0	0	23	23	07MAY	25MAY
Pseudothyatira cymatophoroides (Gn.)	THY	20	2	0	1	23	02JUL	10AUG
Hypagyrtis unipunctata (Haw.)	GEO	5	10	7	1	23	15MAY	07AUG
Heterocampa guttivitta (Wlk.)	NOT	10	0	9	2	21	07JUN	25JUL
Probole amicaria (H.-S.)	GEO	0	1	17	1	19	19JUN	13AUG
Zale minerea (Gn.)	NOC	5	9	3	2	19	21MAY	01AUG
Drepana arcuata Wlk.	DRE	17	0	0	0	17	11JUN	07AUG
Nadata gibbosa (J.E. Smith)	NOT	0	0	0	17	17	18JUN	14AUG
Achatia distincta Hbn.	NOC	6	6	0	3	15	29MAY	27JUN
Orgyia leucostigma (J.E. Smith)	LYM	1	8	3	3	15	17MAY	16JUL
Lithophane antennata (Wlk.)[2]	NOC	11	3	0	1	15	17MAY	07JUN
Ennomos subsignaria (Hbn.)[2]	GEO	0	0	6	8	14	21MAY	26JUN
Acronicta ovata Grt.	NOC	2	0	0	11	13	12JUL	11AUG
Paonias myops (J.E. Smith)[3]	SPH	1	7	0	4	12	06JUL	10AUG
Acronicta hasta Gn.	NOC	3	5	2	0	10	06JUL	14AUG
Orthosia alurina (Sm.)[2]	NOC	2	3	5	0	10	14MAY	20JUN
Crocigrapha normani (Grt.)	NOC	3	6	1	0	10	24MAY	27JUN
Bomolocha baltimoralis (Gn.)	NOC	3	4	3	0	10	11JUL	02AUG
Parallelia bistriaris Hbn.	NOC	1	0	9	0	10	15MAY	10AUG
Anisota virginiensis (Drury)	SAT	0	0	0	9	9	09JUL	09JUL
Acronicta americana (Harr.)[3]	NOC	3	3	2	1	9	09JUL	15AUG
Catocala ultronia (Hbn.)[2]	NOC	0	8	0	0	8	25MAY	01JUN
Biston betularia (L.)	GEO	3	4	0	0	7	02JUL	24JUL
Eutrapela clemataria (J.E. Smith)	GEO	0	3	3	1	7	29MAY	23JUN
Malacosoma americanum (F.)	LAS	0	6	0	1	7	24MAY	13JUN
Symmerista albifrons (J.E. Smith)[2]	NOT	0	0	0	7	7	26JUL	02AUG
Cleora sublunaria (Gn.)[2]	GEO	0	4	2	1	7	26MAY	05JUN
Cladara atroliturata (Wlk.)[3]	GEO	3	1	2	1	7	07JUN	23JUN
Lithophane laticinerea Grt.[2]	NOC	0	4	0	3	7	17MAY	22JUN
Papilio glaucus L.[3]	PAP	0	6	0	0	6	28JUN	24JUL
Colocasia propinquilinea (Grt.)	NOC	4	0	2	0	6	25JUN	21JUL
Lithophane innominata (Sm.)[2, 3]	NOC	2	0	2	2	6	07JUN	14JUN
Lithophane querquera Grt.[2]	NOC	2	0	0	4	6	14MAY	05JUN
Eupsilia morrisoni (Grt.)	NOC	1	0	0	5	6	07MAY	22MAY

continued

Species	Family[1]	No. per host tree					Collection Dates	
		Birch	Cherry	Maple	Oak	Total	First	Last
Protoboarmia porcelaria (Gn.)	GEO	4	1	0	0	5	07MAY	13JUL
Ennomos magnaria Gn.	GEO	0	2	3	0	5	29JUN	13JUL
Furcula borealis (Guer.-Meneville)	NOT	0	5	0	0	5	30JUN	20JUL
Nacophora quernaria (J.E. Smith)	GEO	0	0	0	4	4	02JUL	13JUL
Glena cribrataria (Gn.)	GEO	0	3	0	0	3	30JUL	30JUL
Anacamptodes humaria (Gn.)[2]	GEO	0	3	0	0	3	07JUN	20JUN
Paleacrita vernata (Peck)[2,3]	GEO	0	0	0	3	3	11MAY	11MAY
Plagodis alcoolaria (Gn.)	GEO	0	0	2	1	3	05JUL	09AUG
Prochoerodes transversata (Drury)[2]	GEO	0	2	1	0	3	08JUN	14AUG
Macrurocampa marthesia (Cram.)	NOT	1	0	0	2	3	23JUL	14AUG
Dasychira obliquata (G. & R.)	LYM	0	0	0	3	3	14MAY	23JUL
Zale lunifera (Hbn.)	NOC	0	3	0	0	3	19MAY	19MAY
Acronicta innotata Gn.[2]	NOC	3	0	0	0	3	07AUG	14AUG
Lithophane unimoda (Lint.)[2]	NOC	0	3	0	0	3	15MAY	25MAY
Epimecis hortaria (F.)[2]	GEO	1	0	0	1	2	02JUN	12JUL
Melanolophia signataria (Wlk.)[2]	GEO	2	0	0	0	2	08JUN	08JUN
Plagodis serinaria H.-S.	GEO	0	1	0	1	2	09JUL	20JUL
Heterocampa biundata Wlk.	NOT	1	0	1	0	2	27JUN	07AUG
Dasychira dorsipennata (B. & McD.)	LYM	0	0	0	2	2	30MAY	30MAY
Bomolocha deceptalis (Wlk.)[2]	NOC	0	2	0	0	2	18JUL	18JUL
Catocala andromedae Gn.[2]	NOC	0	0	0	2	2	24MAY	24MAY
Acronicta radcliffei (Harv.)[2]	NOC	0	2	0	0	2	19JUN	19JUN
Alypia octomaculata (F.)[2]	NOC	0	2	0	0	2	01AUG	01AUG
Lithophane semiusta Grt.[2]	NOC	0	0	2	0	2	08JUN	08JUN
Copipanolis styracis (Gn.)[2]	NOC	0	0	0	2	2	15MAY	24MAY
Satyrium liparops (Leconte)[2,3]	LYC	0	0	0	1	1	24MAY	24MAY
Basilarchia arthemis (Drury)[2]	NYM	0	1	0	0	1	12JUL	12JUL
Basilarchia archippus (Cram.)[2]	NYM	0	0	0	1	1	30MAY	30MAY
Pero honestaria (Wlk.)[2]	GEO	0	0	1	0	1	27JUN	27JUN
Lambdina fiscellaria (Gn.)[2]	GEO	0	0	0	1	1	18JUN	18JUN
Lambdina pellucidaria (G. & R.)[2,3]	GEO	0	0	0	1	1	14JUL	14JUL
Eugonobapta nivosaria (Gn.)[2,3]	GEO	0	0	0	1	1	21MAY	21MAY
Nemoria lixaria (Gn.)[2]	GEO	0	1	0	0	1	13JUL	13JUL

continued

[1]GEO = Geometridae, NOC = Noctuidae, ARC = Arctiidae, LAS = Lasiocampidae, NOT = Notodontidae, LYM = Lymantriidae, SAT = Saturniidae, DRE = Drepanidae, SPH = Sphingidae, THY = Thyatiridae, PAP = Papilionidae, NYM = Nymphalidae, LYC = Lycaenidae.

[2]Species that were not collected at Coopers Rock, 1984-1985 (Butler 1992).

[3]Species collected on oak at Fernow that were not collected in Grant and Pendleton counties, 1990–1992 (Butler et al. 1995a). Oak is an expected host for these species.

Species	Family[1]	No. per host tree					Collection Dates	
		Birch	Cherry	Maple	Oak	Total	First	Last
Actias luna (L.)[3]	SAT	0	0	0	1	1	09AUG	09AUG
Peridea angulosa (J.E. Smith)	NOT	0	0	0	1	1	31JUL	31JUL
Schizura unicornis (J.E. Smith)	NOT	0	0	1	0	1	14AUG	14AUG
Oligocentria semirufescens (Wlk.)	NOT	0	1	0	0	1	09AUG	09AUG
Orgyia definita Pack.[2]	LYM	0	1	0	0	1	28JUN	28JUN
Acronicta lobeliae Gn.[2]	NOC	0	0	0	1	1	28JUN	28JUN
Acronicta haesitata (Grt.)[2]	NOC	0	1	0	0	1	17JUL	17JUL
Lithophane grotei Riley	NOC	0	0	0	1	1	24MAY	24MAY

[1]GEO = Geometridae, NOC = Noctuidae, ARC = Arctiidae, LAS = Lasiocampidae, NOT = Notodontidae, LYM = Lymantriidae, SAT = Saturniidae, DRE = Drepanidae, SPH = Sphingidae, THY = Thyatiridae, PAP = Papilionidae, NYM = Nymphalidae, LYC = Lycaenidae.

[2]Species that were not collected at Coopers Rock, 1984-1985 (Butler 1992).

[3]Species collected on oak at Fernow that were not collected in Grant and Pendleton counties, 1990–1992 (Butler et al. 1995a). Oak is an expected host for these species.

TABLE 4.

Species richness and abundance of macrolepidopterous larvae on foliage of four host tree groups at Fernow Experimental Forest, West Virginia, 1989–1994.

Host	Richness	Abundance
black birch	57	1,350
black cherry	71	3,188
mixed maple	57	1,352
mixed oak	72	1,387
TOTAL	111	7,277

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